

KIRK-OTHMER

**CONCISE ENCYCLOPEDIA
OF CHEMICAL TECHNOLOGY**

A WILEY-INTERSCIENCE PUBLICATION
John Wiley & Sons
NEW YORK • CHICHESTER • BRISBANE • TORONTO • SINGAPORE

Copyright © 1985 by John Wiley & Sons, Inc.

All rights reserved. Published simultaneously in Canada.

Reproduction or translation of any part of this work beyond that permitted by Section 107 or 108 of the 1976 United States Copyright Act without the permission of the copyright owner is unlawful. Requests for permission or further information should be addressed to the Permissions Department, John Wiley & Sons, Inc.

Library of Congress Cataloging in Publication Data:

Main entry under title:

Kirk-Othmer Concise encyclopedia of chemical technology.

"A Wiley-Interscience publication."

Abridged version of the 24 volume Encyclopedia of chemical technology. 3rd ed. New York: Wiley, c1978-c1984.

Includes index.

Executive editor, Martin Grayson; associate editor, David Eckroth.

I. Chemistry, Technical—Dictionaries. I. Kirk, Raymond E. (Raymond Eller), 1890-1957. II. Othmer, Donald F. (Donald Frederick), 1904- III. Grayson, Martin. IV. Eckroth, David. V. Encyclopedia of chemical technology. VI. Title: Concise encyclopedia of chemical technology.

TP9.K54 1985 660'.03'21 84-22006

ISBN 0-471-86977-5

ISBN 0-471-51700-3 (pbk.)

Printed in the United States of America

10 9 8 7 6 5 4 3 2

Modification is a perceptual phenomenon. Although the chemical mixtures that are used to change odor perception usually do not react outside of the olfactory organ, modern theory does postulate that chemical complexes involving enzymes are active within the organ. Changes in the way these complexes form may explain why mixtures of odorants vary from individual chemicals in the way they are perceived.

Odors and Their Mixtures

Odor is that property of a substance that makes it perceptible to the sense of smell. Although it is certain that odor is caused by molecular structure, there remains little predictability about this correlation of odor with structures. It is known from experience that certain chemical classes have certain types of odor (see also Flavor characterization), but even an expert cannot predict what an unfamiliar molecule or mixture will smell like.

Intensity perception. The measurable properties of odor perception are its intensity and its character. The measurement and expression of odor mixture intensity can be achieved in a number of ways, but they are almost all subjective. The simplest but the most subjective method is the use of a hedonic scale. The format possibilities are many, eg, 0 = no odor, 1 = barely perceptible, 2 = distinct, 3 = strong, 4 = very strong, and 5 = overpowering.

One of the most objective measures of an odorant's intensity is its threshold which, however, reflects the intensity of only one specific odorant concentration, ie, the weakest that can be detected.

All the senses, including smell, relate to the psychophysical law (Stevens' law) as expressed by the power equation:

$$\psi = k\phi^\beta$$

where ψ is the perceived intensity of the sensation, ie, the odor; k is a constant; and ϕ is the physical intensity of the stimulus, ie, the odorant. Generally, the sensation varies as a power function of the stimulus. In olfaction, the power β is less than one.

Character perception. Odor character is purely subjective. Several chemicals have been experimentally characterized by scaling the degrees to which each chemical possesses subjective reference qualities, eg, burnt, fruity, and spicy. But no method exists that can reliably characterize odors.

Mixture perception (modification). Many odorous and nonodorous chemicals are used to control odors, but only those that work essentially by altering the way the nose perceives the character and intensity are true odor modifiers.

Products

Although the original intent of deodorizers was to reduce malodor, use for decorative purposes is becoming an important factor. The active ingredient of masks and counteractants are oils: essential oils, which are fragrance extracts from flowers, herbs, fruits, and trees; animal extractives; and aroma chemicals, which may be either natural or synthetic.

ROBERT H. BUCKENMAYER
Airwick Industries, Inc.

Ann. N.Y. Acad. Sci. 237, 1 (1974); H.R. Moskowitz and C.L. Gerbers, p. 1. Final Report on Room Deodorizers and Air Fresheners: Markets, Manufacturers, and Chemical Compositions, Battelle Memorial Institute, Columbus Division, Columbus, Ohio, Feb. 28, 1979.

H.R. Moskowitz, *Perfum. Flavor*, 2, 21 (April-May 1977).

OIL SANDS. See Tar sands.

OILS, ESSENTIAL

A simple, though incomplete, definition of essential oils is the following: an essential oil is the predominantly volatile material isolated by

some physical process from an odorous single-species botanical. Over 3000 oils have been identified from the vast number of plant species and several hundred have been commercialized. Of these, some are extremely rare and produced in only kilogram quantities, eg, violet oil, concretes (flower extracts), and angelica root oil.

Essential oils are now generally manufactured close to the growing area. Product quality has suffered, however. Essential oils are easily adulterated and this technology has not been overlooked by isolated local producers.

Essential oils are isolated from various plant parts, such as leaves (patchouli), fruit (mandarin), bark (cinnamon), root (ginger), grass (citronella), wood (anyris), heartwood (cedar), gum (myrrh), balsam (tolu balsam), berries (pimenta), seed (caraway), flowers (rose), twigs (clove stems), and buds (cloves). These plant parts are processed to yield their quintessences or essential oils, which are mostly devoid of cellulose, glycerides, starches, sugars, tannins, salts, and minerals which also occur in these botanicals.

The common physical method for isolating essential oils from the botanical is steam distillation, wherein small amounts of nonvolatiles may be carried over. Some oils are expressed. Many flower oils are extracted with a purified petroleum solvent.

Essential oils are generally liquid at room temperature; however, some are semisolid, such as *Mentha arvensis* (Brazilian mint), and several are solid, eg, oil of guaiac wood.

The cultivation of essential oil-bearing plants has kept pace with modern agricultural methods. Hybrids are grown to yield oils of specific odor, flavor, or properties.

Essential oils are used as such for flavors and fragrances, but products derived from, or based on essential oils have large volume usage for specific applications. Essential oils are concentrated, rectified, extracted, or chemically treated to further isolate vital components, purify, adjust properties, or increase the concentration of significant flavor or fragrance components (see Flavors and spices; Perfumes).

Composition

The volatile components of essential oils usually contain fifteen carbon atoms or less. However, seed oils contain long-chain fatty acids or esters and even glycerides that are carried over in distillation; the amounts of these components are very low.

Essential oils basically are made up of carbon, hydrogen, and oxygen, and occasionally nitrogen and sulfur. The largest class of components is the terpenes which have ten carbon atoms and are head-to-tail condensation products of two isoprene molecules (see Terpenoids). The terpenes may be aliphatic, alicyclic, or bi- and tricyclic of varying degrees of unsaturation up to three double bonds.

It is not uncommon for an essential oil to contain over two hundred components and often the trace substances (in ppm) are essential to the odor and flavor. The absence of even one component may change the aroma. The same species of botanical, grown in different parts of the world, usually has the same components; however, climatic and topographical conditions affect plants and can alter the essential oil quantitatively, but rarely qualitatively.

Production

In the botanical, the essential oil is present in oil sacs. It is isolated by comminution, and the action of heat, water, and solvents.

Steam distillation. Steam or hydrodistillation is the preferred method for producing essential oils, employing either water, wet steam, or steam.

Extraction. An essential oil that is sensitive to heat, eg, jasmine or tuberose, or contains an essential nonvolatile constituent, eg, piperine in black pepper, is extracted with a solvent (see Extraction).

Synthetic Substitutes for Essential Oils

Fluctuations in the cost and availability of natural oils and the high cost of some oils have induced users to seek substitutes. Several former large-volume oils have been replaced by synthetics because of large volume demands. The expensive variations in cost are especially evident in essences such as rose, jasmine, violet, lilac, neroli, etc. Duplication of these items is economically worthwhile. Modern techniques and instru-

